

ELECTRONIC DEVICE FOR DELIVERING YARN TO TEXTILE  
MACHINES

The present invention refers to an electronic device  
5 for delivering yarn to textile machines.

Yarn-feed reels of a textile machine are usually set on  
the top frame of the machine or on a side reel-frame;  
in this arrangement, the side reel-frame occupies more  
space, but enables an increase in the number of yarn  
10 feeds, the possibility of resorting to double feed at  
each drop and the possibility of changing the empty  
reels more easily and rapidly.

On textile machines with rotating skirts, the reel  
frame is fixed to, and set in continuous rotation with,  
15 the skirts themselves.

In any case, prior to arriving at the needles, the yarn  
follows a rather long path, to give the machine time to  
stop before a possible broken end gets caught up.

On the most recent circular machines for hosiery,  
20 control of the feed is extremely important; for this  
reason, positive feeders can be used, which release to  
the needles a length of yarn that is as constant as  
possible in time, or accumulation feeders are provided,  
which maintain the tension of the yarn as constant as  
25 possible.

The positive feeder most widely used at the moment is the ribbon feeder, whereby a ribbon runs all around the circumference of the machine, at each drop; the yarn acquires the speed of the ribbon , so as to obtain a  
5 more uniform fabric, regulating the absorption on all the drops with just one operation in so far as, necessarily, all the threads of yarn are fed the individual drops at the same speed.

Alternatively, control of the positive feeders of the  
10 yarn can be obtained by means of interchangeable gears located in a special gear-case and by expandable pulleys with manual adjustment.

Adjustment of the expandable pulleys is carried out by slackening a belt, using a belt-tensioner, and then by  
15 releasing a ring nut using a pin provided so as to gain access to the plate of the pulley; it is thus possible to adjust the diameter by rotating the aforementioned plate of the pulley, which is provided with reference marks and finally to re-tighten the ring nut.

20 Upon request, further gears are available for different feeds of the yarn and arrangements of the textile machines to accept one-way or multiple-way positive heads, as well as different sizes of the belts.

However, the drawbacks deriving from using similar  
25 devices are known; in particular, it is not possible to

obtain (and to program) a predetermined ratio of synchronism between the delivery speed of yarn and the peripheral speed of the main cylinder of the textile machine; moreover, the use of transmission belts forces  
5 each device to be maintained in fixed positions over the circumference of the textile machine and does not allow an easy and quick identification of the position of the drop in which breaking of the yarn occurs in the event of faults of the machine.

10 A purpose of the present invention is therefore to overcome the drawbacks mentioned and in particular to provide an electronic device for delivering yarn to textile machines, which enables adjustment of the delivery of yarn by varying the speed of a d.c. motor  
15 so as to keep it as synchronised as possible, according to an adjustable scale factor, with the speed of the textile machine served.

Another purpose of the present invention is to provide an electronic device for delivering yarn to textile  
20 machines, which enables programming of suitable unwinding values for each thread, so as to obtain a process flexibility, unlike the traditional systems.

Another purpose of the invention is to provide an electronic device for delivering yarn to textile  
25 machines, which is able to identify the position of the

broken thread in the event of breaking of the yarn.

A further purpose of the present invention is to provide an electronic device for delivering yarn to textile machines which does not involve the use of  
5 transmission belts, so that each device can be fixed in different positions from those attached to the circumference of the cylinder of the machine.

A further purpose of the present invention is to provide an electronic device for delivering yarn to  
10 textile machines which is able to stop and to start up, even when the textile machine is working, in synchronism with the functioning of the thread-tighteners of the machine, in case of textile machines having striping devices with many thread-tighteners for  
15 each stitching station, which are able to deliver threads of different colours or materials for each drop according to a prefixed and programmable sequence, are used.

Another purpose of the invention is to provide an  
20 electronic device for delivering yarn to textile machines, which does not involve the use of complex technologies and which enables substantial reduction of processing times and of losses in productivity losses, as compared to known techniques by managing the  
25 production processes in a more appropriate way.

The above and other purposes are achieved by an electronic device for delivering yarn to textile machines according to claim 1, to which the reader is referred for reasons of brevity.

5 Advantageously, each supply reel or bobbin of each single thread to deliver to the textile machine is equipped with a motor, which is controlled by an electronic control board, so as to keep synchronism between the speed of delivering of each thread and the  
10 speed of rotation of the cylinder of the textile machine.

The system, therefore, is able to feed the thread from a single feed point (knitted thread) of the machine, so as to enable adjustment and programming a synchronism  
15 ratio between the speed of the motor of each reel and the speed of the textile machine.

Application of said electronic device for each knitted thread of the textile machine also enables adjustment and programming a prefixed value of thread unwinding,  
20 for each thread, so as to obtain a suitable processing flexibility.

Moreover, in the event of breaking of a single thread, it is possible, through serial communication, to identify which electronic device has detected the error  
25 (i.e. the breaking); the above also allows for speeding

up times for searching errors (the broken threads) and moreover the possibility of reprogramming a synchronism ratio while the textile machine is working enables knitting effects that cannot be obtained with other  
5 traditional systems.

Further purposes and advantages of the present invention will emerge clearly from the ensuing description and from the attached schematic drawings, which are provided purely by way of explanatory and  
10 non-limiting example of embodiment, in which:

- figure 1 shows schematic perspective view of an electronic device for delivering yarn to textile machines, according to the present invention;
- figure 1A shows a schematic sectional view of an  
15 electronic device for delivering yarn to textile machines, according to an alternative embodiment of the invention with respect to the embodiment showed in figure 1;
- figure 2 is a schematic top view of a series of  
20 electronic devices for delivering yarn, connected together, according to the invention;
- figure 3 is a schematic bottom view of the electronic devices of figure 2.

With reference to the aforementioned figures, the  
25 electronic device for delivering yarn to textile

machines, according to the invention, enables adjustment of the delivery of each thread 11 by varying the speed of rotation of a motor 1, so as to maintain said speed of rotation as synchronised as possible,  
5 according to an adjustable scale factor, with the speed of the textile machine served.

The electronic device substantially comprises the motor 1 and an electronic control board 2, which includes a microcontroller, which enables the control of rotation  
10 speed of the motor 1 and of the currents in the phases of said motor 1.

The electronic device also comprises a yarn-winding wheel 3, fitted onto the shaft of the motor 1 or incorporated directly on the rotating body of said  
15 motor 1, as shown in figure 1A, said wheel 3 being suitably shaped so as to ensure the correct winding and unwinding of each thread 11; the device also include a pair of small mobile arms, respectively designated by 8 and 10, which are suitable for checking the presence of  
20 each thread 11 both at the entrance and at the exit of said yarn-winding wheel 3.

The position of such small arms 8, 10 is detected through "Hall effect" sensors and magnets associated to said small arms 8, 10, while the signals of said  
25 sensors and magnets are detected by the microcontroller

of the electronic board 2.

The device according to the invention, finally, has a support and attachment plate 4, a support 5 for the yarn-guiding tube 12, a thread-tightener 6, a stopper  
5 device 7 and a thread-tightener ring 9.

In particular, in preferred but not limiting embodiments of the present invention it is foreseen to use, as the motor 1, a 12 pole d.c. brushless motor, equipped with "Hall effect" sensors for detecting the  
10 position of the rotor placed outside said motor 1.

The control board 2, which comprise the microcontroller, controls a commutation driver of the phases of motor 1 and adjusts the current to be delivered to said motor phases; moreover, the  
15 microcontroller reads the analogue signals delivered by the "Hall effect" sensors, which refer to the position of the motor 1, and moreover said microcontroller reads the input frequency signal delivered by an "encoder" device, which is fitted on the rotating cylinder of the  
20 textile machine.

Finally, the control board 2 acquires by reading the logical signals delivered by a set of sensors, which can be activated for interrupting the deliver of yarn, and manages an asynchronous serial interface, of the  
25 RS485 "half-duplex" type, so as to communicate with the

central electronic controller of the textile machine for receiving the configuration parameters, including the synchronism ratio between the delivering speed of the yarn and the rotating speed of the cylinder of the textile machine.

In particular, the microcontroller of the board 2 receives from a buffer of an RS485 serial line the configuration commands and transmits, upon command, the information regarding the current situation, driving the signalling outputs accordingly. The above information is acquired by reading the logic signals coming from a set of sensors for arrest of the yarn or from a manual command for excluding said arrest by reading signals generated by a reference encoder of the textile machine and comparing said signals with the signals coming from the encoder fitted on the shaft of the motor 1.

The electronic device for delivering yarn according to the present invention can finally include an output of an open-collector type, which can be used for remote signalling of a condition of collective arrest, and a set of LEDs for remote display of a state of machine arrest.

By taking into account just the advance pulses, the microcontroller of the board 2 calculates the

difference between the number of pulses received from the two encoders, either incrementing or decrementing the count; the instantaneous value totalized by the counter with appropriate corrective factors that can be  
5 modified by manual commands issued on the serial line, is used as reference of speed of the analogue and power section.

In addition, the microcontroller of the electronic board 2 sends further commands to the analog section  
10 for switching of the phases, said commands being defined according to the dedicated device used for controlling the current in the phases of the d.c. brushless motor 1; in particular, such commands may consist simply of a dynamic brake command issued when  
15 it is desired to stop the motor 1 or directly of the commands for enabling the three branches of the power bridge, acquired by the microcontroller by decoding the signals for the position of the rotor of the motor 1 with respect to the stator.

20 The analogue and power section is made up of a signal portion and a power portion; the signal portion receives the logic signals produced by one or more encoders of the motor 1 and, from these, via a frequency/voltage converter, derives a unidirectional  
25 tachimetric signal, of an analogue type, which is

compared with the speed reference generated by the microcontroller of the board 2.

In addition, since the motor 1 is a d.c. brushless motor, at each instant it is possible to energize the  
5 three windings, so as to obtain advance of the rotor according to the current position thereof; in practice, with the three canonical combinations of use of the winding of the motor 1, which carry out energizing of just two windings at a time, it is possible to exploit  
10 a further three intermediate switching combinations, in which, alternately, one winding is connected to the positive side of a supply bus and the other two windings, simultaneously, to the negative side of the supply bus, or vice versa, thus obtaining 6 switches  
15 for each pole of the motor, to which there correspond 6 equidistant angular advances of the rotor.

It has already been stated that each electronic device for delivering yarn, according to the present invention, comprises a motor 1, a first encoder for  
20 detecting the position of the rotor of said motor 1, which generates the logic control signals, and a local encoder, both of which are fitted on the shaft of the motor 1.

The local encoder may be obtained using a magnetised  
25 wheel having a diameter that is compatible with the

dimensions of the motor 1 and is equipped with magnetic poles; for reading, pairs of "Hall effect" sensors are preferably used, so as to enable discrimination of the direction of revolution, whilst the signals generated  
5 may be the classic channels A, B (signal CHB), or else a clock having a frequency proportional to the r.p.m. of the motor 1 (which reaches a maximum of approximately 10,000 r.p.m.) and a bit for the direction of revolution (signal CHA).

10 The local encoder may then be eliminated if the logic control signals enable a sufficiently regular movement to be obtained at a low r.p.m.. Finally, the electronic device for delivering yarn comprises a local power supply, of a linear type, which enables a reduced  
15 voltage for supplying electric power to the control board 2, as well as a possible intermediate voltage for the drivers of the power bridge, to be obtained directly from the supply voltage; the power of the bridge and the value of said intermediate voltage  
20 depend upon the characteristics of the dedicated device used for controlling the current in the phases of the brushless motor 1.

Furthermore, an electrolytic capacitor of adequate capacitance provides local coverage of the current  
25 peaks absorbed by the motor 1 and initially absorbs the

voltage peaks during deceleration, whilst the remaining energy must be absorbed by the d.c. power supply.

As already explained in detail previously, each electronic device for delivering yarn is therefore able  
5 to deliver each thread 11 from a single deliver point (knitted yarn) of the textile machine, thus obtaining a synchronism ratio between the speed of the motor 1 (and of the wheel 3) and the speed of the textile machine to be programmed, through the RS485 half-duplex  
10 asynchronous serial interface of the control board 2.

Therefore, according to the present invention, each wheel 3 for delivering each thread 11 of the yarn to the textile machine is equipped with the motor 1, which is controlled by the control board 2 and which allows  
15 for maintaining the speed of said wheel 3 in synchronism with the speed of the rotating cylinder of the textile machine.

The use of an electronic device according to the invention, which is provided for each thread 11 of the  
20 yarn knitted by the machine, thus, enables synchronism among the wheels 3 onto which each thread 11 passes; it is thus possible to program in different ways each device, so as to obtain whatever combination and flexibility of processing, unlike the known systems.

25 A synchronism ratio may also be reprogrammed when the

textile machine is working, so as to obtain programmed sequences of yarn delivering, unlike the traditional systems.

The elimination of transmission belts, with respect to  
5 known devices, furthermore, allows the attachment of each device in different positions to those attached to the cylinder of the textile machine.

Finally, in the event of breaking of a single thread  
11, it is possible to identify, by means of serial  
10 communication, what is the device which has detected the error; in fact, said information can be sent to the central controller of the textile machine, thus quickly allowing the identification of the deliver point that has caused the machine to stop. Also, said information  
15 is stored in a memory, so as to detect further possible errors on the same deliver point.

Moreover, the possibility of reprogramming the synchronism ratio, when the machine is working, enables new stitching effects and allows for deactivating the  
20 synchronism command on one or more devices, by means of the central controller of the machine; in addition, it is easier to provide for reknitting the yarn after closing the needles' eyes, as compared to known techniques.

25 In fact, the operation of absorption of yarn by the

needles is different from a suitable operation of absorption and therefore it is necessary to have a different synchronism ratio or even to eliminate the control of the motor.

5 As already stated, the electronic control board 2 of the motor 1 also enables a stop of the machine if the motor 1 has lost its synchronism due to an anomalous tension of the thread 11 entering the wheel 3; this enables detection of friction points of the thread 11  
10 along its path which do not allow a suitable unwinding of the thread 11 from the reel.

The characteristics of the electronic device for delivering yarn to textile machines, which forms the subject of the present invention, as well as the  
15 advantages, emerge clearly from the foregoing description.

Finally, it is clear that numerous variations may be made to the electronic device referred to herein, without thereby departing from the principles of  
20 novelty inherent in the inventive idea. It is likewise clear that, in the practical implementation of the invention, the materials, shapes and dimensions of the items illustrated may be any whatsoever according to the requirements, and may be replaced with other  
25 technically equivalent ones.